Precision of a meteor's impact position on the Earth

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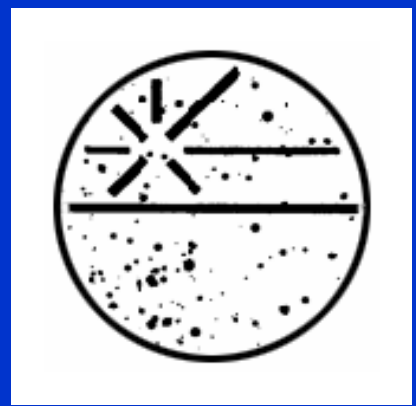
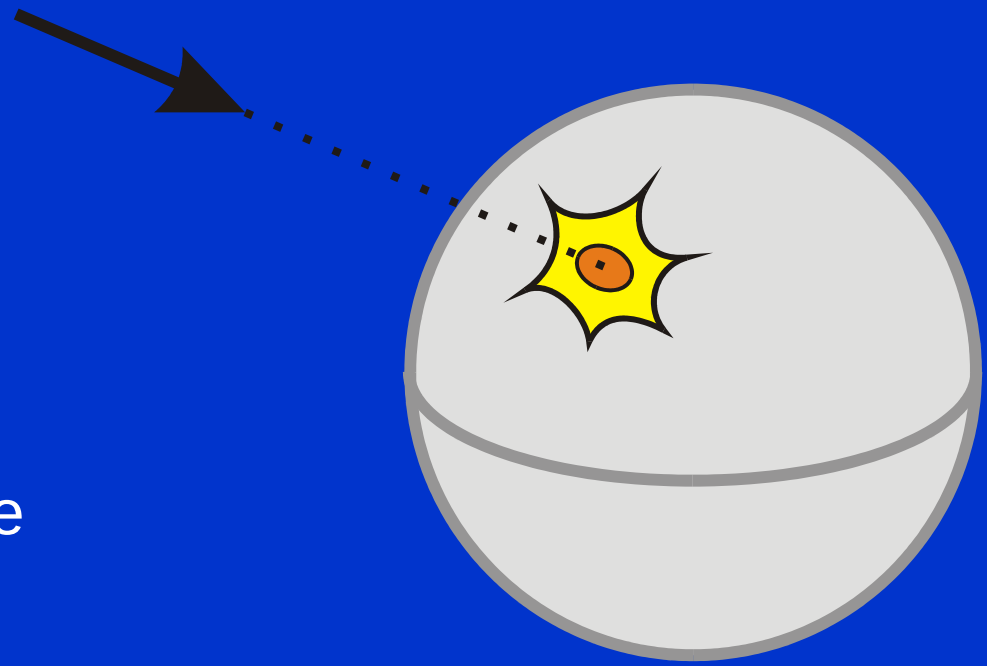


IMC 2007 Barèges, France

Objective and Assumptions

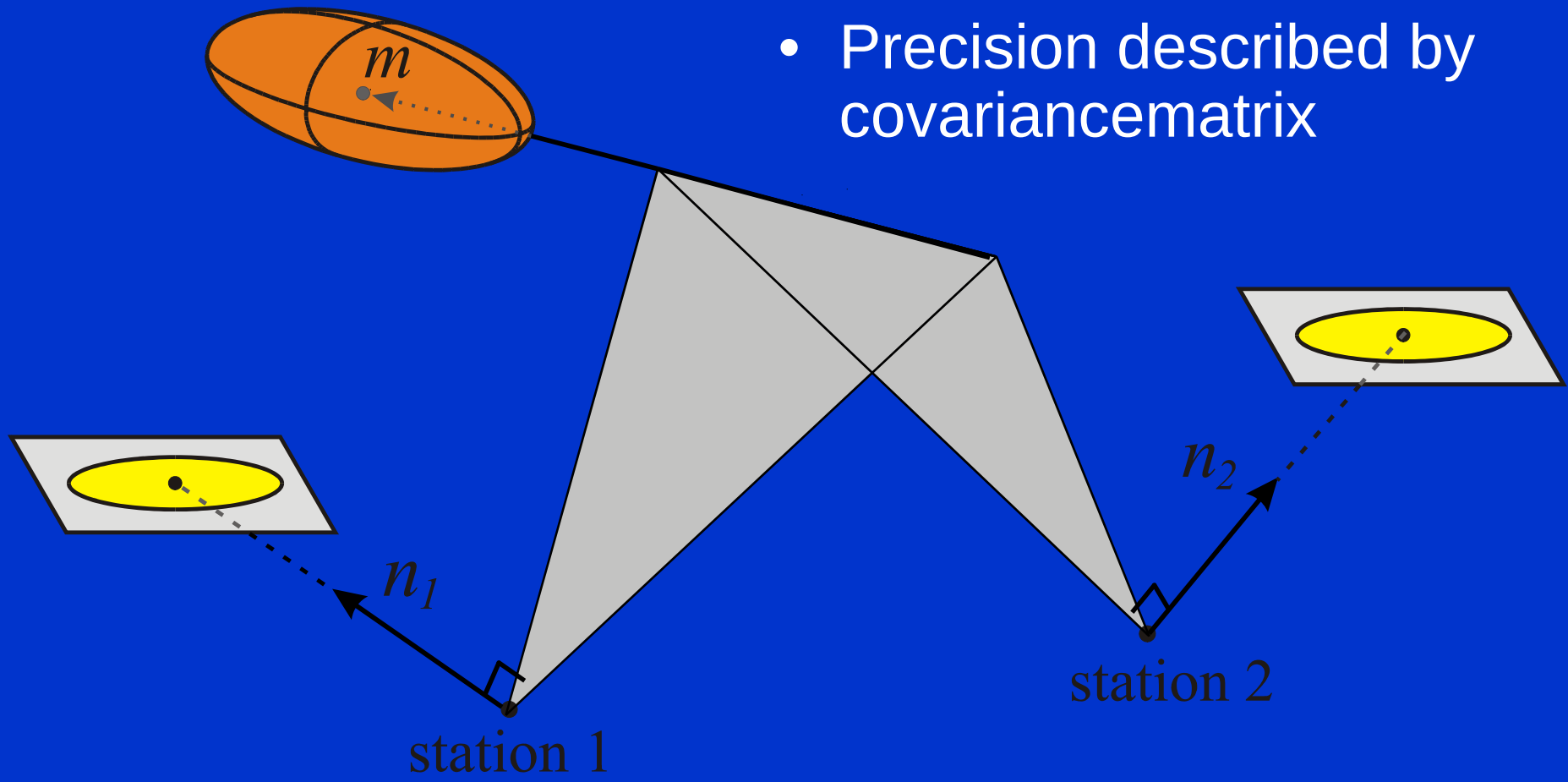
- Objective:
  Impact position +
  Error ellipse



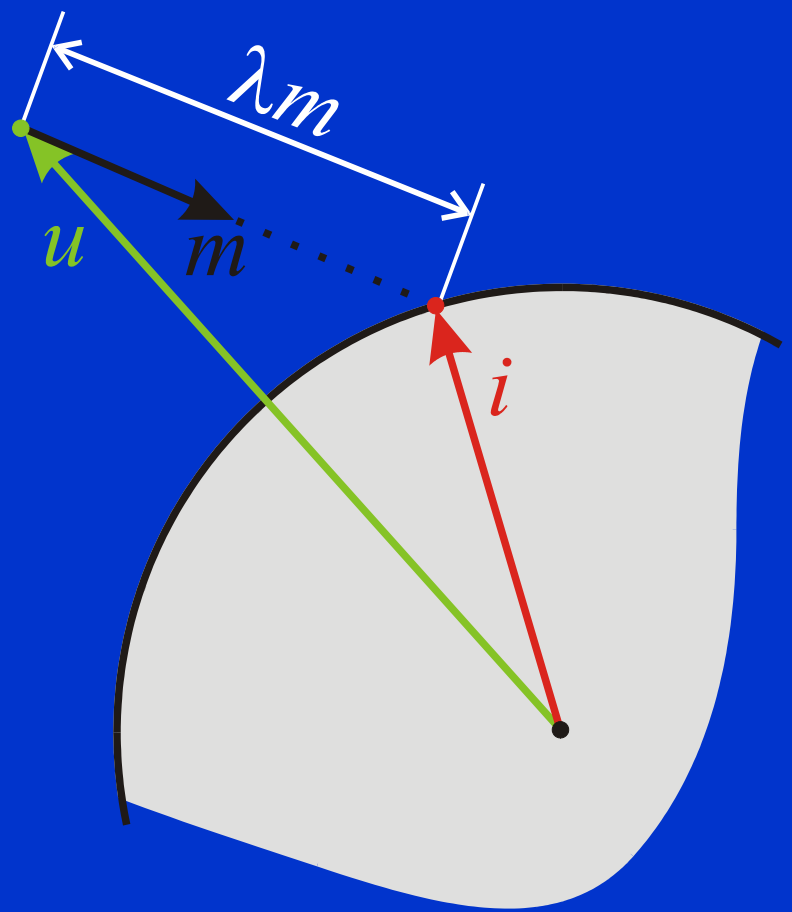
- Assumptions:
  - Meteor is straight line
  - No gravity correction
  - No refraction correction
  - No drag correction

Used initial parameters

- Model presented at IMC 2005
- Precision described by covariancematrix



Calculate Impact Point



1) Equation of Impact Point:

$$\begin{pmatrix} i_x \\ i_y \\ i_z \end{pmatrix} = \begin{pmatrix} u_x \\ u_y \\ u_z \end{pmatrix} + \lambda \begin{pmatrix} m_x \\ m_y \\ m_z \end{pmatrix} \quad (I)$$

2) Equation of Earth's surface:

$$\frac{x^2}{a^2} + \frac{y^2}{a^2} + \frac{z^2}{b^2} = 1 \quad (II)$$

a *and* b *used from GRS-80 ellipsoid*

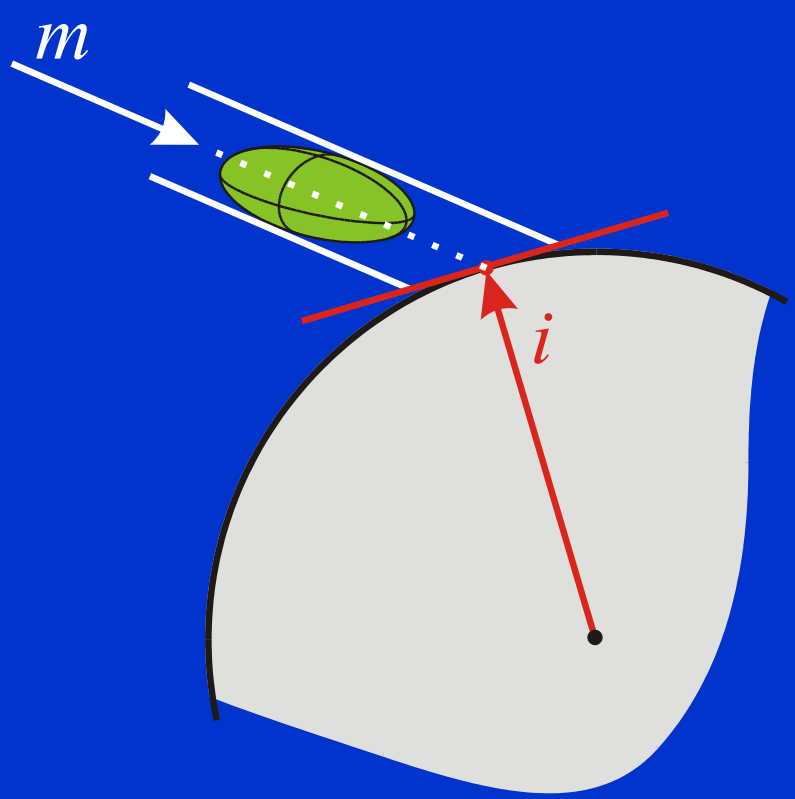
3) Solution for λ:

Substitution of equation (I) in equation (II) gives λ

Propagation of stochastic part of m to impact point i

1) Law of propagation of (co)variances:

$$i = u + \lambda \cdot m$$
$$Q_{i_{ellipsoid}} = \lambda \cdot Q_m \cdot \lambda$$



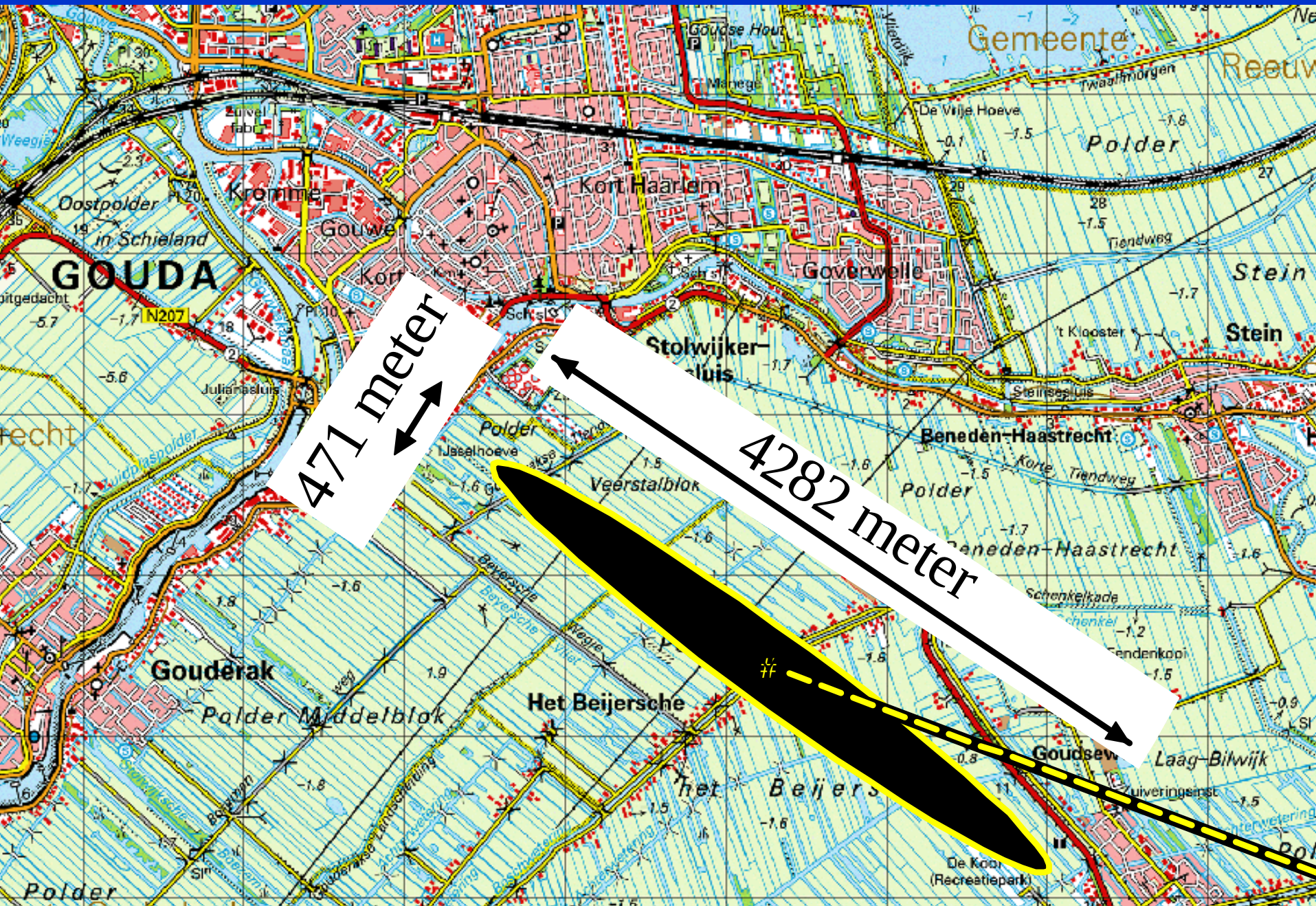
2) Projection:

$$Q_{i_{ellipse}} = P \cdot Q_{i_{ellipsoid}} \cdot P^T$$

3) Result:

Ellipse on tangent plane of impact point i

Impact Point of Meteor “Heesch – Meteren , 22 april 2001”

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Meteor Attack!


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Acknowledgements

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Gerard Terpstra & Frank Janssens

Conclusions

Size of Error ellipse:

- *magnitude of measurement errors on impact point*

Shape of Error ellipse caused by:

- *difference in measurement error of station 1 & station 2*
- *station ~ meteor configuration*
- *angle of impact*